

Teacher Information

Bottle Rocket

Objective:

To construct and launch a simple bottle rocket.

Description:

Working in teams, learners will construct a simple bottle rocket from 2-liter soft drink bottles and other materials.

Science Standards:

Physical Science - Position and motion of objects
Science and Technology - Abilities of technological design

Science Process Skills:

Measuring
Making Models

Mathematics Standards:

Mathematical Connections
Measurement
Geometry and Spatial Sense

Materials and Tools:

- 2-liter plastic soft drink bottles
- Low-temperature glue guns
- Poster board
- Tape
- Modeling clay
- Scissors
- Safety Glasses
- Decals
- Stickers
- Marker pens
- Launch pad from the Bottle Rocket Launcher

Management:

This activity can stand alone or be incorporated in the activity *Project X-35* that follows. Having the learners work in teams will reduce the amount of materials required. Begin saving 2-liter bottles several weeks in advance to have a sufficient supply for your class. You will need to have at least one bottle rocket launcher. Construct the launcher described in the previous activity or obtain one from a science or technology education supply catalog.

The simplest way to construct the rockets is to use low-temperature electric glue guns that are available from craft stores. High-temperature glue guns will melt the plastic bottles. Provide glue guns for each table or

set up glue stations in various parts of the room.

Collect a variety of decorative materials before beginning this activity so students can customize their rockets. When the rockets are complete, test fly them. Refer to the *Altitude Tracker* activity starting on page 69 for information on determining how high the rockets fly. While one group of students launches their rocket, have another group track the rocket and determine its altitude.

When launching rockets, it is important for the other students to stand back. Countdowns help everybody to know when the rocket will lift off. In group discussion, have your students create launch safety rules



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that everybody must follow. Include how far back observers should stand, how many people should prepare the rocket for launch, who should retrieve the rocket, etc.

Background Information:

Bottle rockets are excellent devices for investigating Newton's Three Laws of Motion. The rocket will remain on the launch pad until an unbalanced force is exerted propelling the rocket upward (First Law). The amount of force depends upon how much air you pumped inside the rocket (Second Law). You can increase the force further by adding a small amount of water to the rocket. This increases the mass the rocket expels by the air pressure. Finally, the action force of the air (and water) as it rushes out the nozzle creates an equal and opposite reaction force propelling the rocket upward (Third Law).

The fourth instruction on the Student Page asks the students to press modeling clay into the nose cone of the rocket. Placing 50 to 100 grams of clay into the cone helps to stabilize the rocket by moving the center of mass farther from the center of pressure. For a complete explanation of how this works, see pages 21-22.

Procedures:

Refer to the Student Page for procedures and optional directions for making paper helicopters. See the extension section below for details on how to use the helicopters.

Assessment:

Evaluate each bottle rocket on its quality of construction. Observe how well fins align and attach to the bottle. Also observe how straight the nose cone is at the top of the rocket. If you choose to measure how high the rockets fly, compare the altitude the rockets reach with their design and quality of the construction.

Extensions:

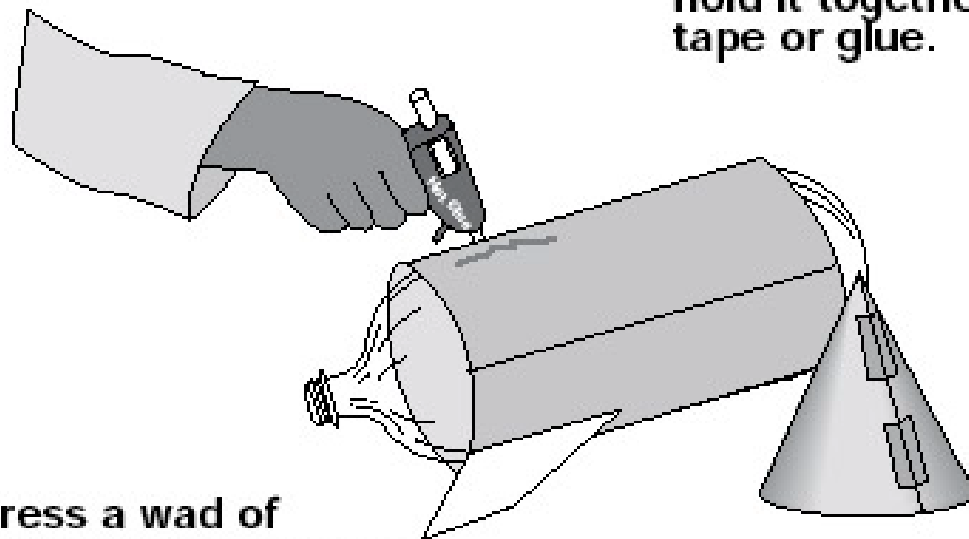
- Challenge rocket teams to invent a way to attach a parachute to the rocket that will deploy on the rocket's way back down.
- Parachutes for bottle rockets can be made from a plastic bag and string. The nose cone is merely placed over the rocket and parachute for launch. The cone needs to fit properly for launch or it will slip off. The modeling clay in the cone will cause the cone to fall off, deploying the parachute or paper helicopters, after the rocket tilts over at the top of its flight.
- Extend the poster board tube above the rounded end of the bottle. This will make a payload compartment for lofting various items with the rocket. Payloads might include streamers or paper helicopters that will spill out when the rocket reaches the top of its flight. Copy and distribute the page on how to make paper helicopters. Ask the students to identify other possible payloads for the rocket. If students suggest launching small animals with their rockets, discuss the purpose of flying animals and the possible dangers if they are actually flown.
- Conduct flight experiments by varying the amount of air pressure and water to the rocket before launch. Have the students develop experimental test procedures and control for variables.

Building A Bottle Rocket

1. Wrap and glue or tape a tube of posterboard around the bottle.

2. Cut out several fins of any shape and glue them to the tube.

3. Form a nosecone and hold it together with tape or glue.



4. Press a wad of modeling clay into the top of the nosecone.

5. Glue or tape nosecone to upper end of bottle.

6. Decorate your rocket.



Paper Helicopter Plans

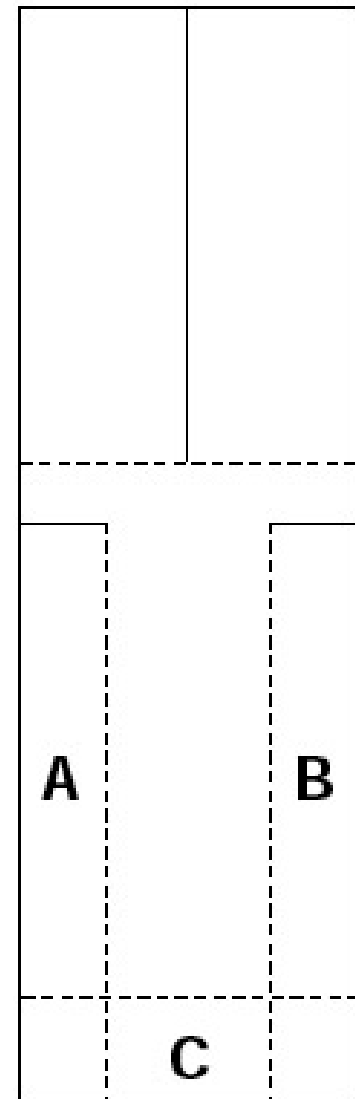
1. Cut on solid black lines.
Fold on dashed lines.

2. Fold A and B
to middle.

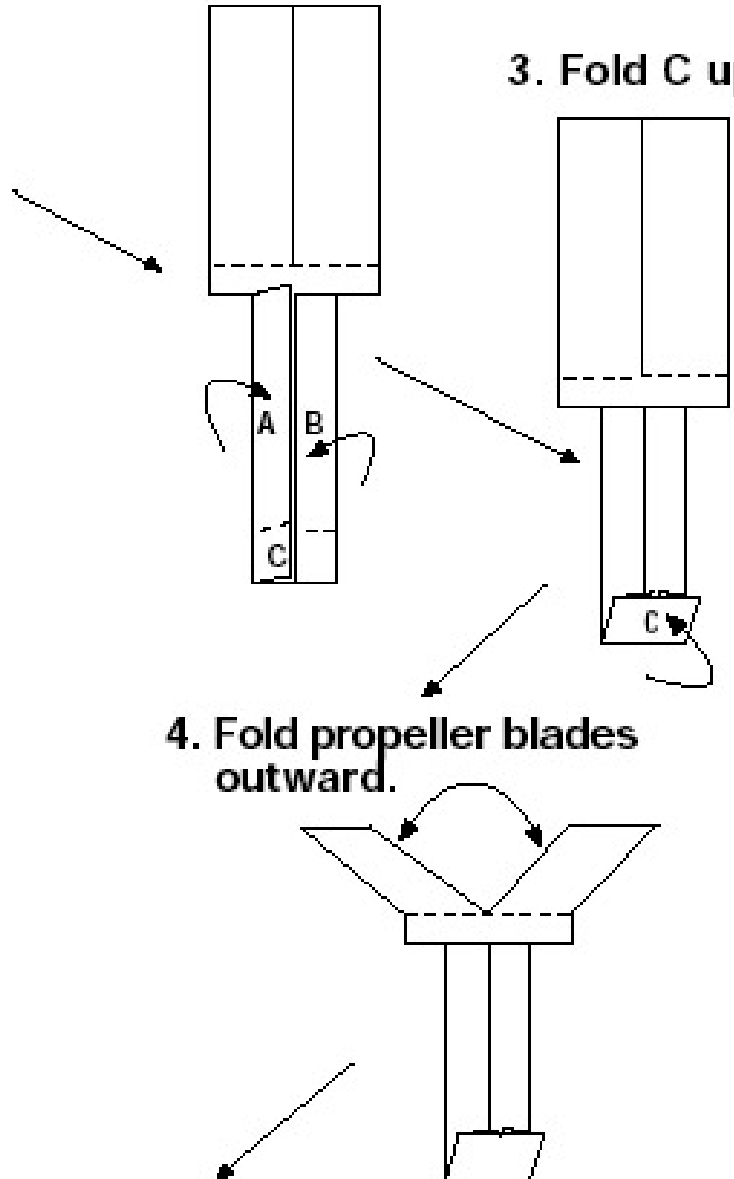
3. Fold C up.

4. Fold propeller blades
outward.

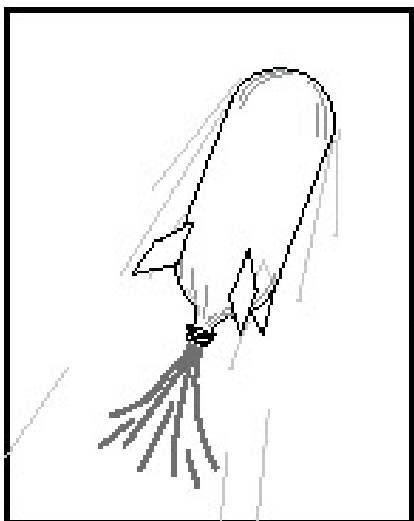
5. Test fly by dropping
from over your head.



Paper Helicopter
Pattern



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Teacher Information

Bottle Rocket Launcher

Objective:

To construct a bottle rocket launcher for use with the *Bottle Rocket* and *Project X-35* activities.

Description:

Students construct a bottle launcher from "off-the-shelf" hardware and wood using simple tools.

Science Standards:

Physical Science - Position and motion of objects
Science and Technology - Abilities of technological design

Science Process Skills:

Measuring

Mathematics Standards:

Mathematical Connections
Measurement

Management:

Consult the materials and tools list to determine what you will need to construct a single bottle rocket launcher. The launcher is simple and inexpensive to construct. Most needed parts are available from hardware stores. In addition you will need a tire valve from an auto parts store and a rubber bottle stopper from a school science experiment. The most difficult task is to drill a $\frac{3}{8}$ inch hole in the mending plate called for in the materials list. Electric drills are a common household tool. If you do not have access to one, or do not wish to drill the holes in the metal mending plate, find someone who can do the job for you. Ask a teacher or student in your school's industrial arts shop, a fellow teacher, or the parent of one of your students to help.

Materials and Tools:

- * 4 5-inch corner irons with 12 $\frac{3}{4}$ inch wood screws to fit
- * 1 5-inch mounting plate
- * 2 6-inch spikes
- * 2 10-inch spikes or metal tent stakes
- * 2 5-inch by $\frac{1}{4}$ inch carriage bolts with six $\frac{1}{4}$ inch nuts
- * 1 3-inch eyebolt with two nuts and washers
- * 4 $\frac{3}{4}$ -inch diameter washers to fit bolts
- * 1 Number 3 rubber stopper with a single hole
- * 1 Snap-In Tubeless Tire Valve (small 0.453 inch hole, 2 inch long)
- * Wood board 12 by 18 by $\frac{3}{4}$ inches
- * 1 2-liter plastic bottle
- * Electric drill and bits including a $\frac{3}{8}$ inch bit
- * Screw driver
- * Pliers or open-end wrench to fit nuts
- * Vice
- * 12 feet of $\frac{1}{4}$ inch cord
- * Pencil

If you have each student construct a bottle rocket, having more than one launcher may be advisable. Because the rockets are projectiles, safely using more than one launcher will require careful planning and possibly additional supervision. Please refer to the launch safety instructions.

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